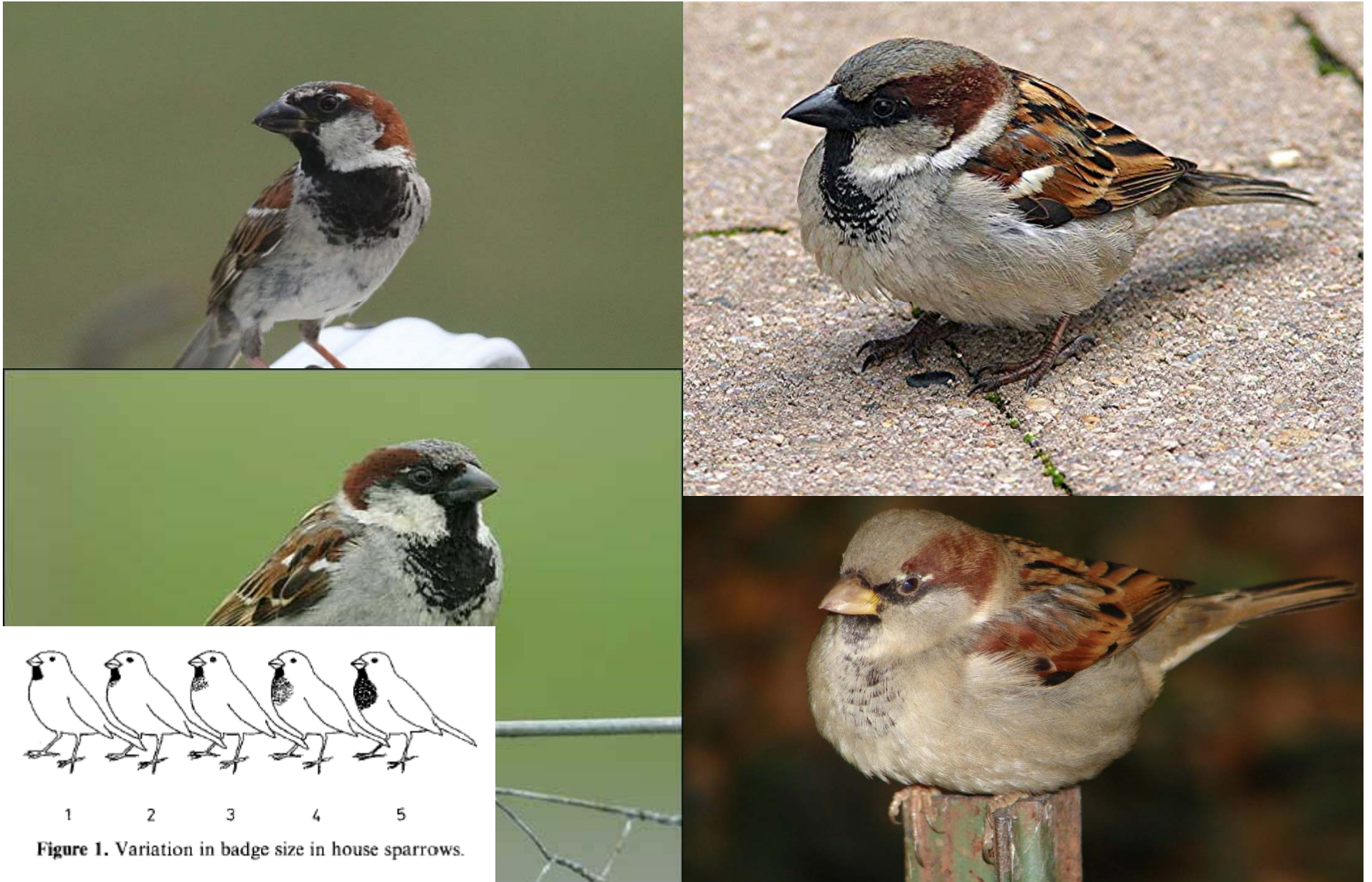


# Most common birds in New York City



House sparrow (introduced)

# House sparrow (male dominance hierarchy)



# Animal mind

(animal cognition and consciousness)

# What is cognition?

the activities of thinking, understanding, learning, and remembering (Webster's)

## What is animal cognition?

Animal cognition refers to the mechanisms by which animals acquire, process, store, and act on information from the environment.

-- animals process information.

perception, learning, memory, decision-making

examples:

# Cognition vs. Consciousness

Respond to events (cognition) vs.

Be aware of events (consciousness  
: internal mental state)




Moths fly into flames, what is  
in the moth's mind?

What is in a termite's mind?





Evidence for consciousness in humans consists of what people say about their mental experience. But for not-verbal animal species.....how to demonstrate their consciousness?



I am  
happy!



# Study animal mind:

## 1. ~~Anthropomorphism~~



## Happiness of Fish (~ c. 300 BC)

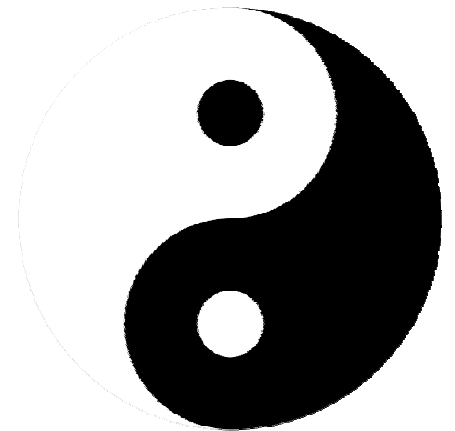
Zhuangzi and Huizi were strolling along the dam of the Hao Waterfall when Zhuangzi said, "See how the minnows come out and dart around where they please! That's what fish really enjoy!"

Huizi said, "You're not a fish — how do you know what fish enjoy?"

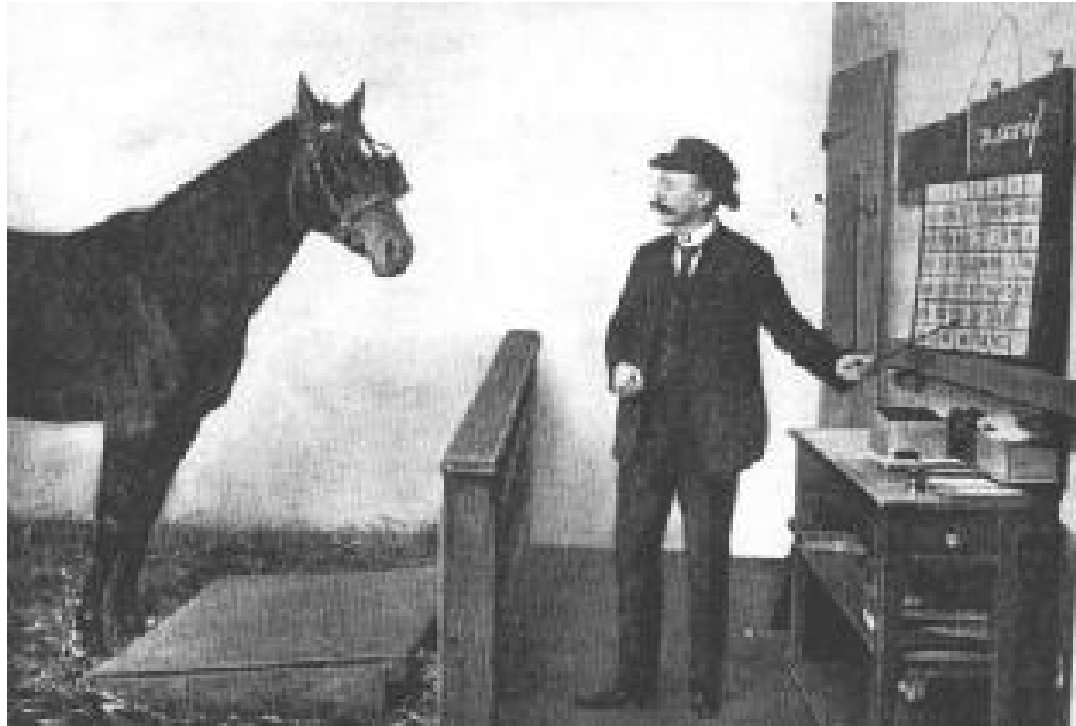
Zhuangzi said, "You're not me, so how do you know I don't know what fish enjoy?"

Huizi said, "I'm not you, so I certainly don't know what you know. On the other hand, you're certainly not a fish, so that still proves you don't know what fish enjoy!"

Zhuangzi said, "Let's go back to your original question, please. You asked me *how* I know what fish enjoy — so you already knew I knew it when you asked the question. I know it by standing here beside the Hao."



# Clever Hans



In late 1800s, a German mathematics professor, Von Osten, firmly believed that humanity had greatly underestimated the reasoning skills and intelligence of animals. He tested his idea with his horse, Hans.



“What is the square root of sixteen?” Four taps.

“What is the date of the following Monday?” Six hoof-taps .

89% accuracy.

Hans’ grasp of mathematics was equivalent to a fourteen-year-old’s.

However,

If the questioner to stand farther away, something interesting happened: the horse's accuracy diminished.

Or, if the questioner didn't know the answer to a question in advance, the accuracy of Hans' responses plummeted to nearly zero.





Hans was merely being receptive to the subtle, unconscious cues which were universally present in his human questioners. There is evidence to indicate that horses may possess an enhanced sensitivity to inconspicuous body language, perhaps as a key part of their social interactions with other horses.

What do you learn from this Clever Hans's story?

1. Horses are “clever” in their own way  
(sensitive to the facial expression )
2. Carefully design experiments and  
interpret results for cognitive study

# What animal behavior suggests conscious thinking?

## 1. Behavioral versatility:

Complex behavior that the animal has never performed before  
(adaptability to changing circumstances)

- Japanese macaques learned a new way to separate grain from inedible materials.
- Milk-bottle opening by blue tits

## 2. Complex, sequential behavior with modifiability

- tool using of chimpanzees (and New Calidonia crows), and the young learns from its parents
- assassin bug camouflage-assisted prey capture
- waggle dance of honey bees
- Killdeer predator-distraction behavior
- food storing in scrub jays

# The Blue tits open milk bottles





# Are blue tits so smart?

Exercising a combination of insight  
and planning;  
Saw an opportunity and exploited it.





## Are blue tits so smart?

**Or** this behavior is part of their daily routine behavior (get an insect hidden in the tree bark), but they accidentally apply it to the bottle, and it works.

And this behavior quickly spread much of England

Animals are most  
“intelligent” to best  
adapt to its local  
species-specific  
environment.



Killdeer bird fakes being injured  
(when predators approach its nest)



# The most common mammals in NYC



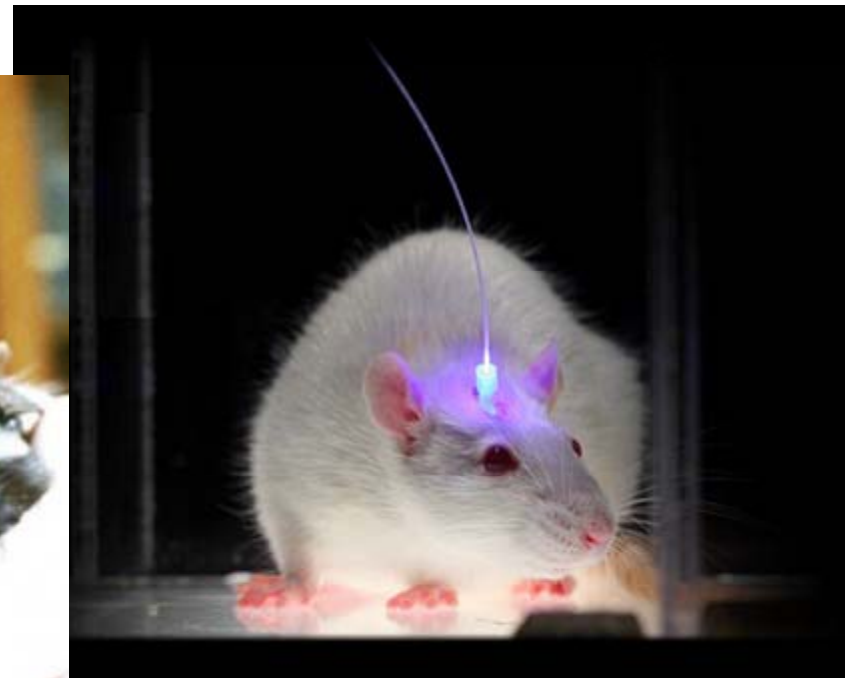
**Rats Mob the Upper East Side**



## Brown rat (common rat, Norway rat)

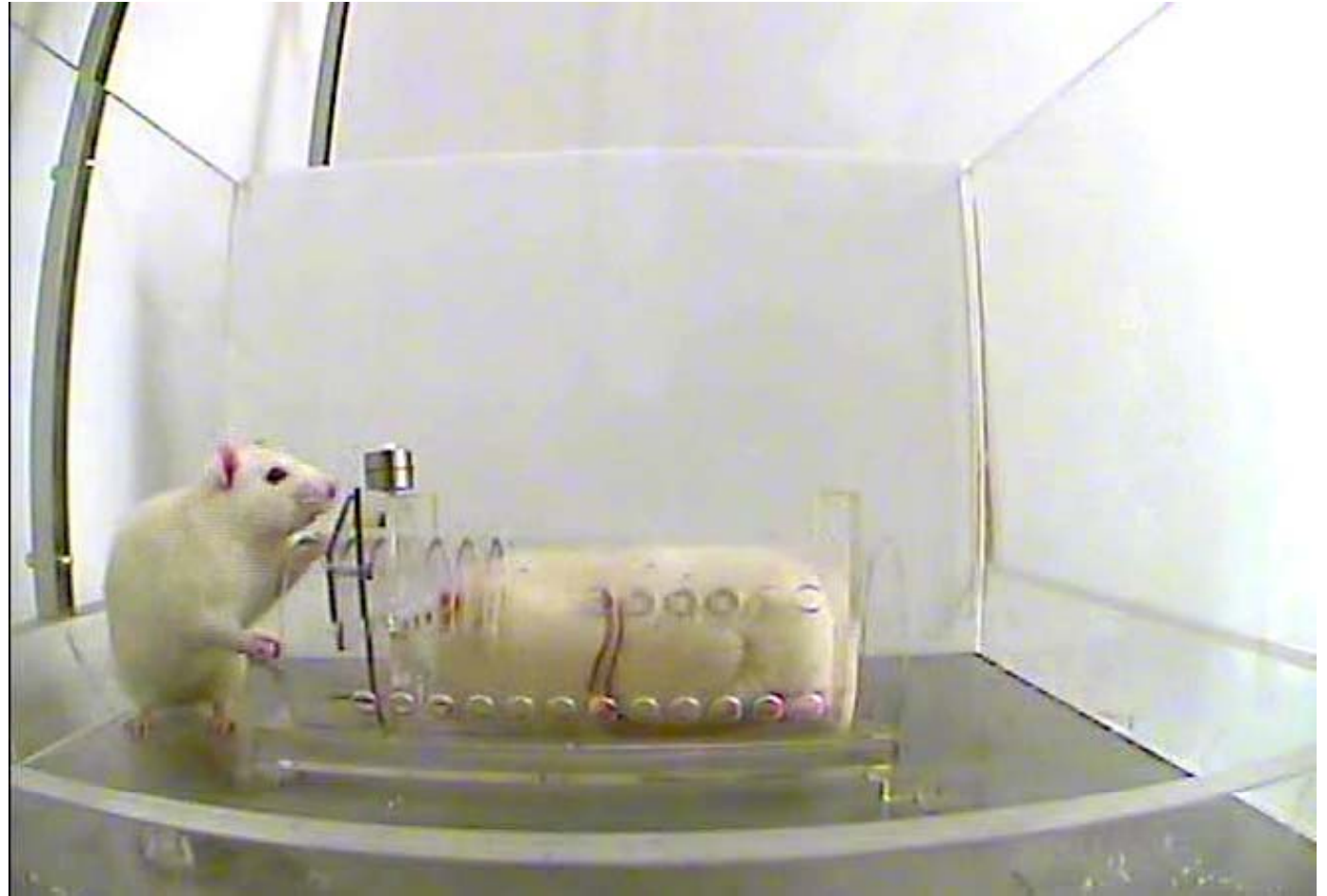
Originated in China, widespread in all continents.  
One of the most successful mammals on the planet after humans.

Omnivore: highly social: dominance hierarchy..  
One of the most used model animals (for biomedical research) –easy to breed.





# Empathy in rats (to eat or to help)



# How to study animal mind?

1. Ecological approach: analyze information processing animals do in situations of ecological importance (foraging, mate choice, navigation....)
2. Psychological approach: seeking to understand human-like performance in other species.

Integrating 1 and 2

# Ecological approach

Understand animal's natural behavior is essential to study their intelligence or mind.

- A. Observe how animals behave in nature → hypothesis testing.
- B. Conduct experiments in lab.

## Jane Goodall: pioneered primatologist (1934~ )



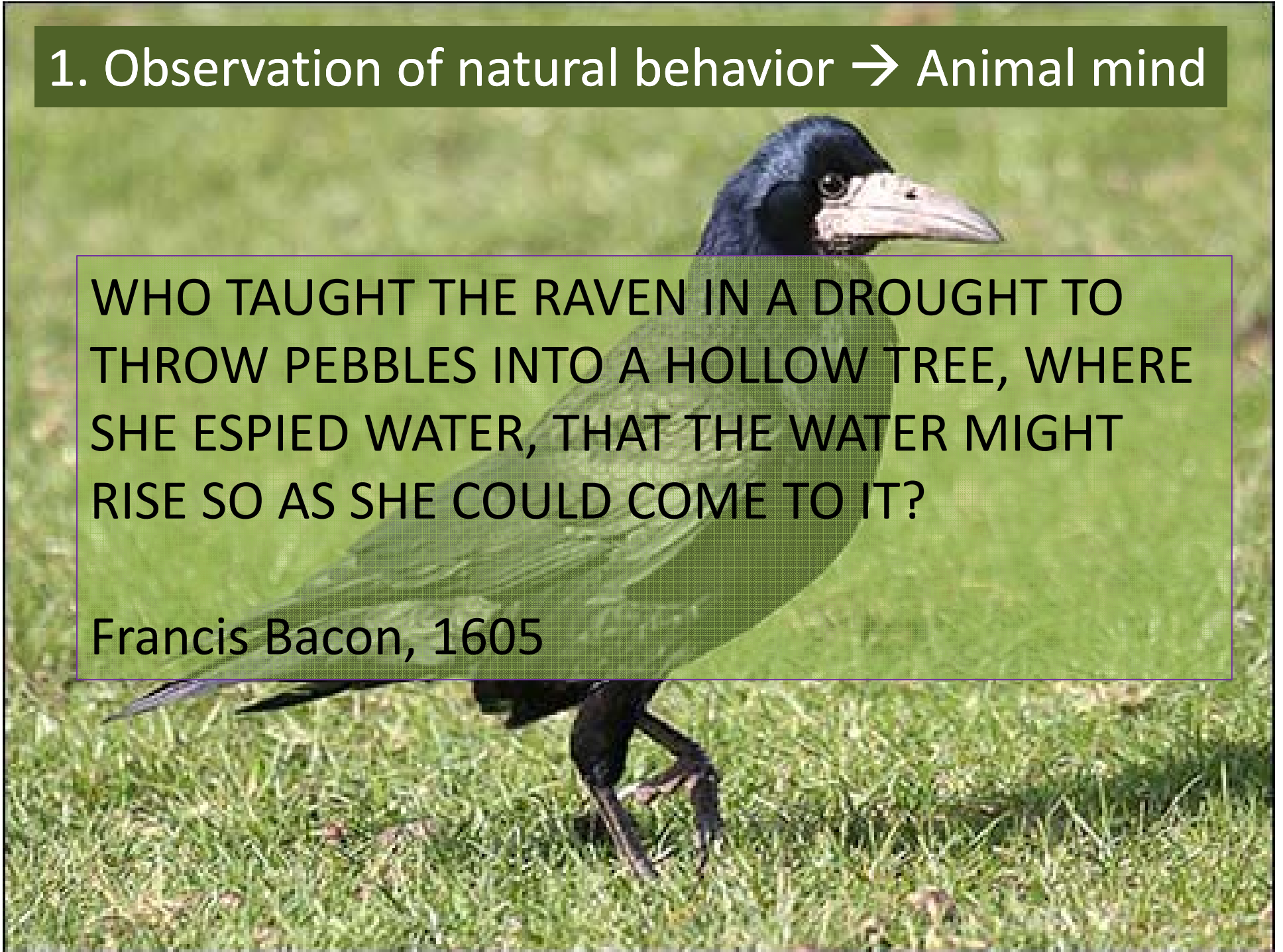
Her methods of studying animals in the wild, which emphasized patient observation over long periods of time of both social groups and individual animals, changed not only how chimpanzees as a species are understood, but also how studies of many different kinds of animals are carried out.



# 1. Observation of natural behavior → Animal mind

WHO TAUGHT THE RAVEN IN A DROUGHT TO  
THROW PEBBLES INTO A HOLLOW TREE, WHERE  
SHE ESPIED WATER, THAT THE WATER MIGHT  
RISE SO AS SHE COULD COME TO IT?

Francis Bacon, 1605





*Thomas Bewick*

*Select Fables of  
Aesop and others,  
1784*

*FABLE XLVIII.*

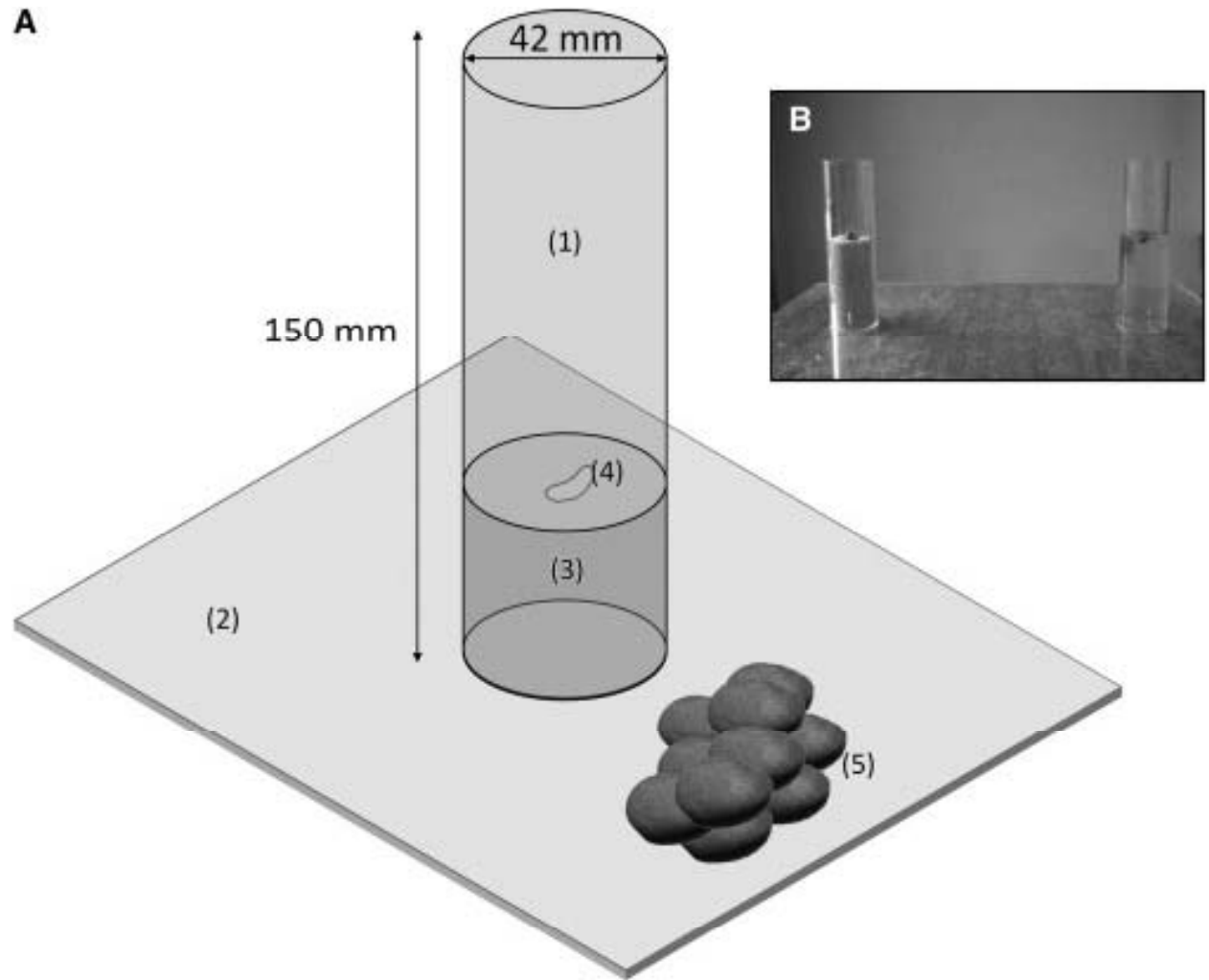
*The Crow and the Pitcher.*

A CROW, ready to die with thirst, flew with joy to a pitcher which he beheld at some distance. When he came, he found water in it indeed, but so near the bottom, that with all his stooping and straining, he was not able to reach it. Then he endeavoured to overturn the pitcher, that so at least he might be able to get a little of it; but his strength was not sufficient for this. At last, seeing some pebbles lie near the place, he cast them one by one into the pitcher; and thus, by degrees, raised the water up to the very brim, and satisfied his thirst.

## 2. Conduct experiments in the lab

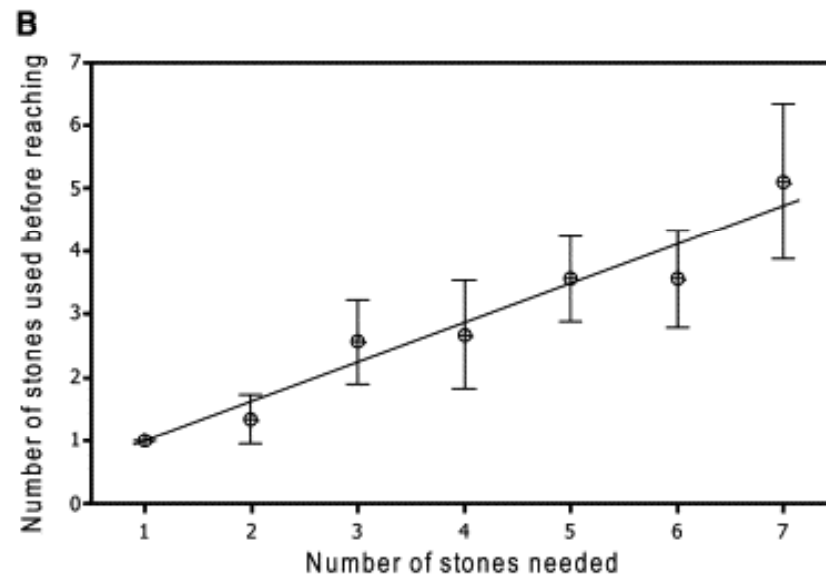
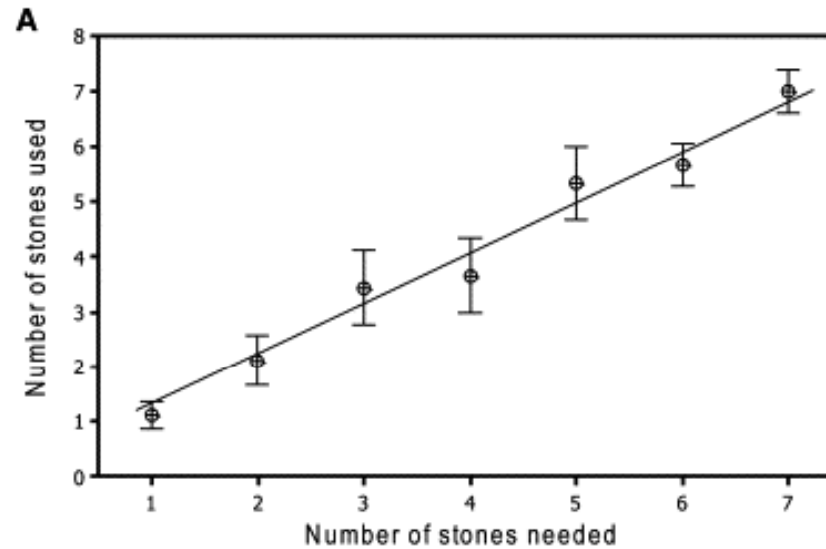


Rook



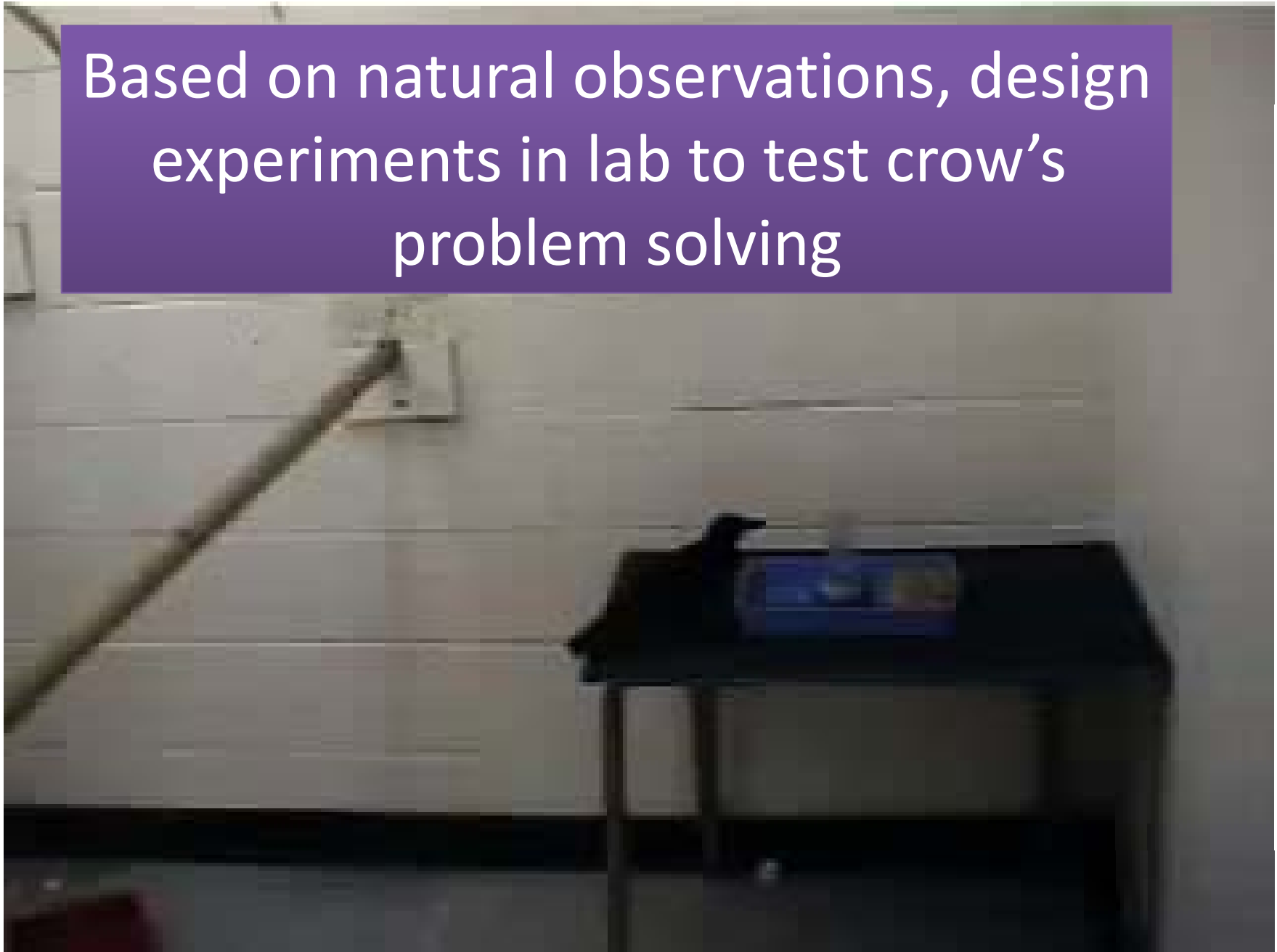


Rook puts in the exact number of stones needed to raise the water level to a reachable height





Based on natural observations, design experiments in lab to test crow's problem solving



# Video #1: how smart are dogs?

1. What is special about Border Collie (ranked as the smartest dog breed)?  
Why do they develop such good memory?
2. Why do dogs provide a better animal model for study of social intelligence than chimpanzees? – emotion tolerance

# Video #2: how smart are dolphins?

1. Can dolphins understand by reading a symbol?
2. Show creative intelligence than following the direction(conditioning) – problem solving/ planning : examples?
3. Do they know the concept of command and communicate with each other, example?

# Video #3: how smart is octopus?

1. Octopus uses brain power to create camouflage to match the a variety of background in 7/10 seconds?
2. What is “Parsimony principle” for cuttlefish’s camouflage behavior?
3. How can octopus’s amazing camouflage tell us about evolution of cognition?

# Video #4: how smart are parrots?

1. What's the difference between parrots and other animals to study animal cognition?
2. What is Irene's methods to train the parrots? Rival-model → purpose?

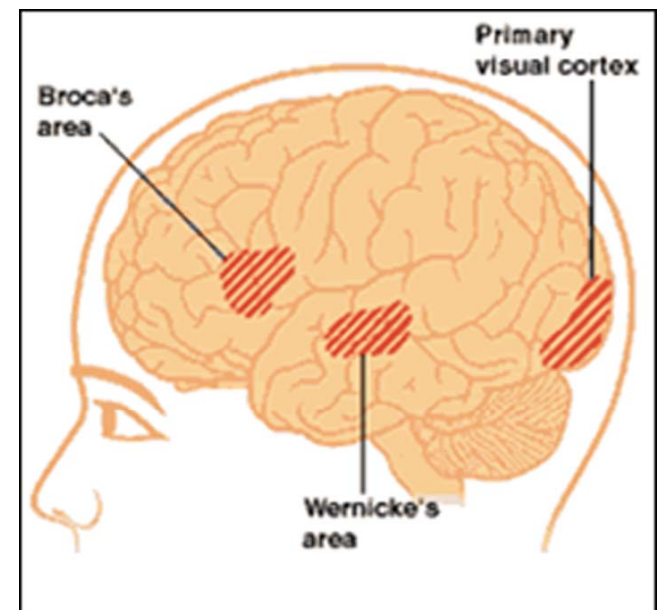


1. Are Alex's vocalizations language?
2. Is Alex capable of thinking? Or it is another example of Clever Hans?  
Or another example of operant conditioning (Skinner box)?
3. How does Alex's skill differ from that of dolphins or chimps?
4. Which of the following views do you agree?
  - a. Dr. Herbert Terrace: Alex was doing a rote response: a complex discriminative performance. An external stimulus to guide Alex's response.
  - b. Dr. Donald Griffin: animals are capable of complex thought and behavior that are not instinctive.
  - c. Dr. Steven Pinker: even complex behavior/ thought in humans can be instinctive.



# Vocal mimics and evolution of mind

Parrot and songbird vocalizations share a similar neural circuit to the spoken language in humans— not only in motor (vocal) learning, but also in perceptual (auditory) learning.



birds have music appreciation?



birds have music appreciation?

The logo for the publication NewScientist, featuring the word in a bold, white, sans-serif font against a dark blue background.

**NewScientist**

A header for an article titled 'Parrot dancing linked to mimicry', with the text in white on a blue background.

**Parrot dancing linked to mimicry**

How does music evolve ?

Why has music evolved in humans?

Perhaps vocal mimics in birds,  
like speech learning in humans, share  
similar neural process and brain areas  
for evolving complex vocal and  
auditory learning / processing.

Language → evolving music?

Music → evolving language?

Complex cognitive ability, brain structure  
→ evolving music and language

# Study animal mind:

## Social intelligence

show:

Mutualism;

Reciprocity;

Altruism;

Sympathy

# Study of animal mind:

## Invertebrates

Foraging behavior of honey bees  
--Waggle dance...

Altruism, reciprocity, or sympathy require animals to understand a great deal about social relationship and group dynamics.

→ Individual understand and then manipulate or help each other.

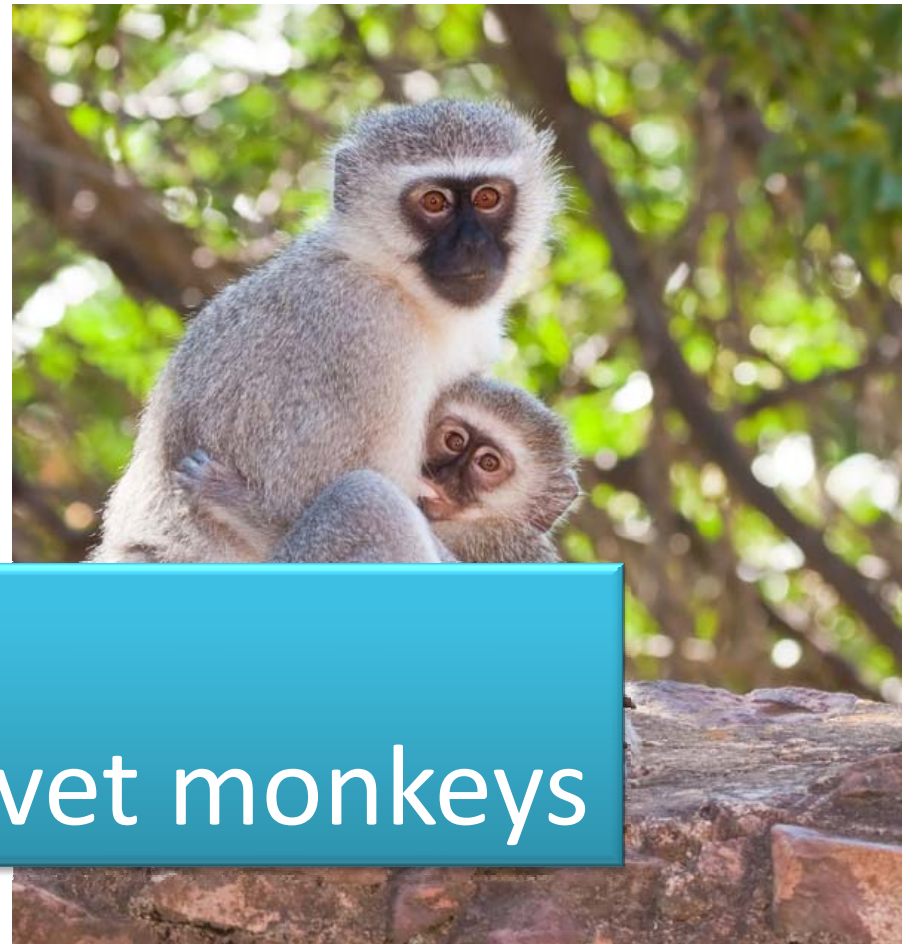


Social animals understand a great deal about social relationship and group dynamics.

Example #1:  
Alarm calls of Ground squirrels



Social animals understand a great deal about social relationship and group dynamics.



Example #2:  
Alarm calls of Velvet monkeys

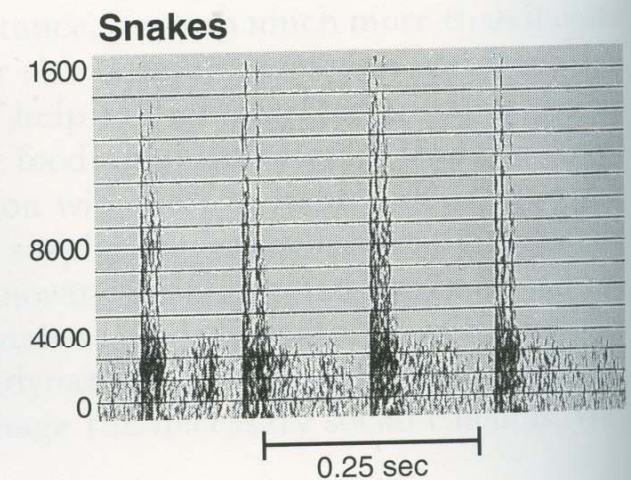
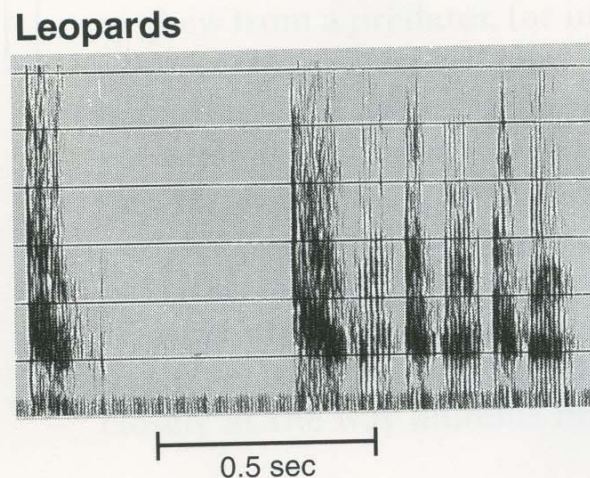
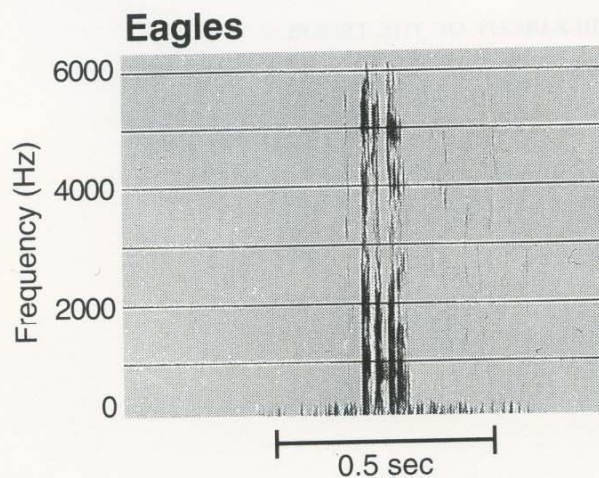
# Velvet monkey: four alarm calls

#1: for aerial predators (Eagles)

#2: for terrestrial predators (Leopards)

#3: for snakes

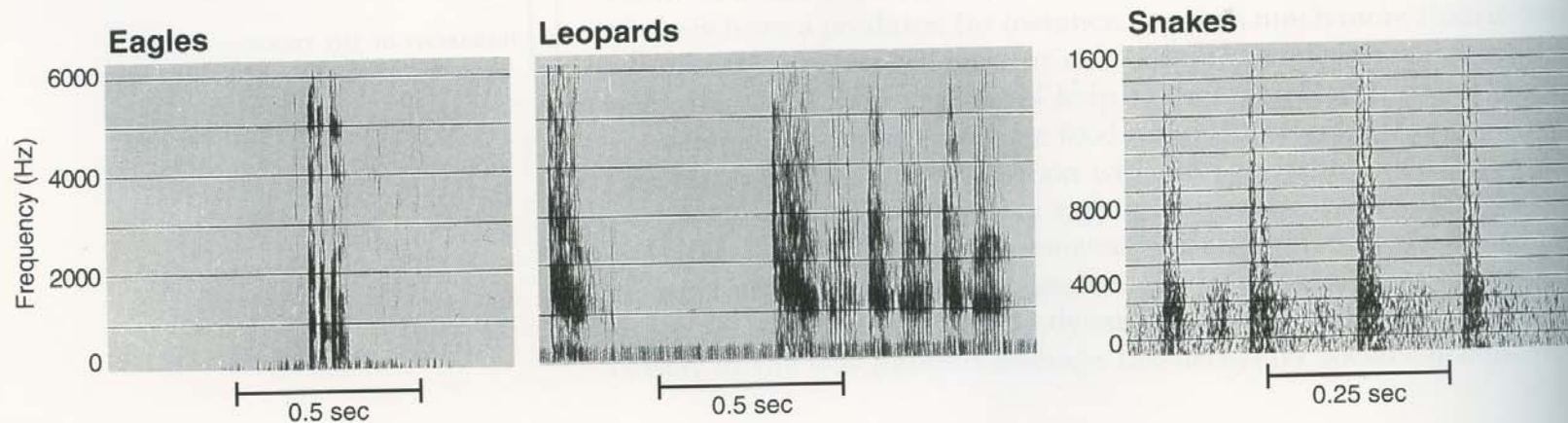
#4: for group-hunting predator.



All of the calls are **innately** produced  
and **innately** recognized

But juveniles still have to learn from adults  
what is the real threat.

They understand exactly what each call means,  
How credible each caller is.

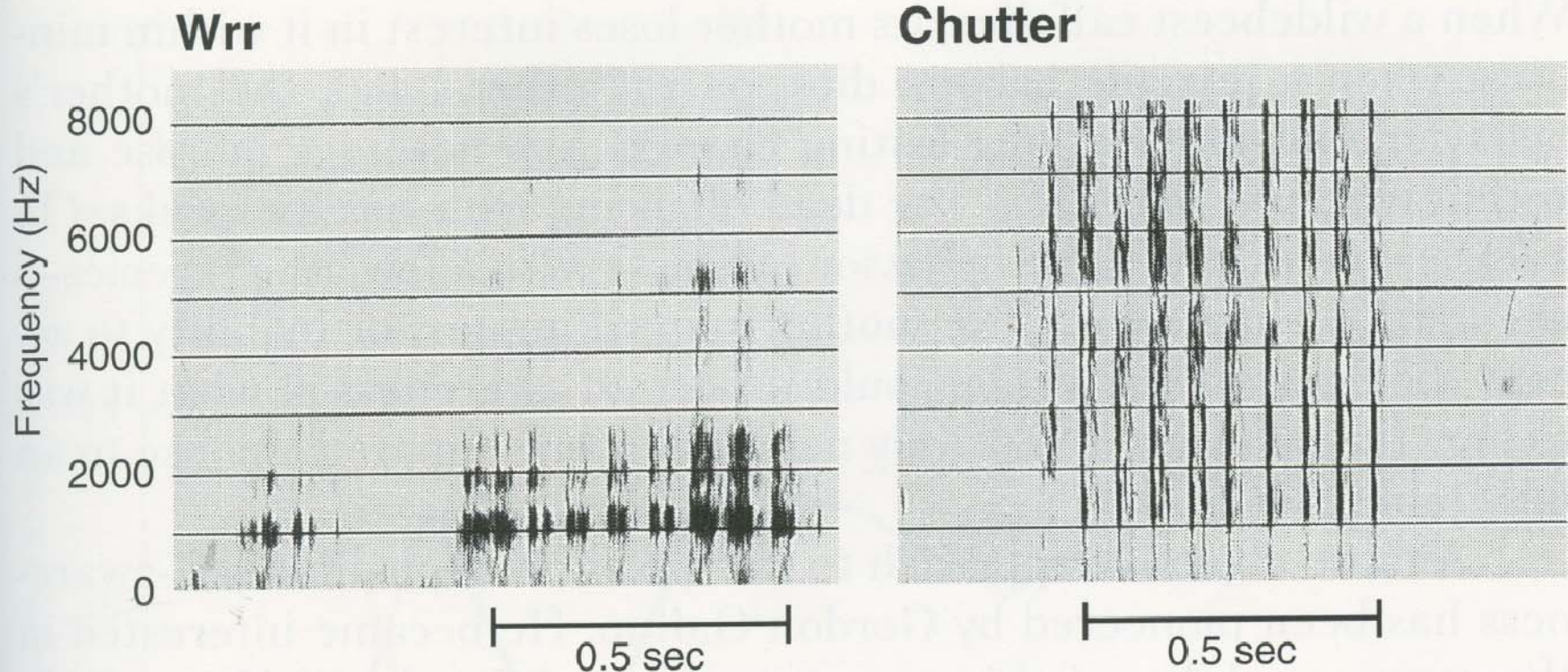




## Velvet monkey: two other calls

#1: Wrr call: signals the initial sighting of another group

#2: Chutter call: serious signals that induces more aggressive interaction



Group members have different responses toward these calls dependent on who is the caller.

They understand their own and on another's social standing and adjust their behavior accordingly.

But, does this imply the monkeys have a **self-image**?

# Self-Image (self-awareness)

I think therefore I am?



## How do you test?



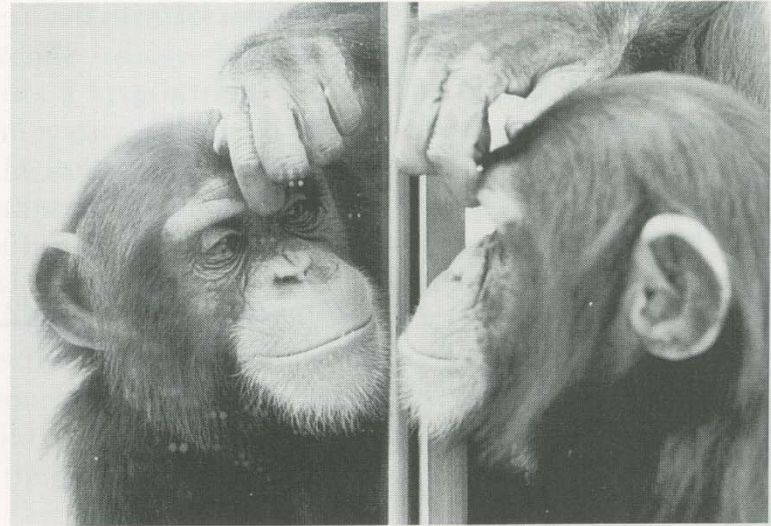
# Self-Image (self-awareness)

While visiting a zoo, Darwin held a mirror up to an orangutan and recorded the animal's reaction, which included making a series of facial expressions. Darwin noted that the significance of these expressions was ambiguous, and could either signify that the primate was making expressions at what it perceived to be another animal, or it could be playing a sort of game with a new toy.

# Mark tests in primates

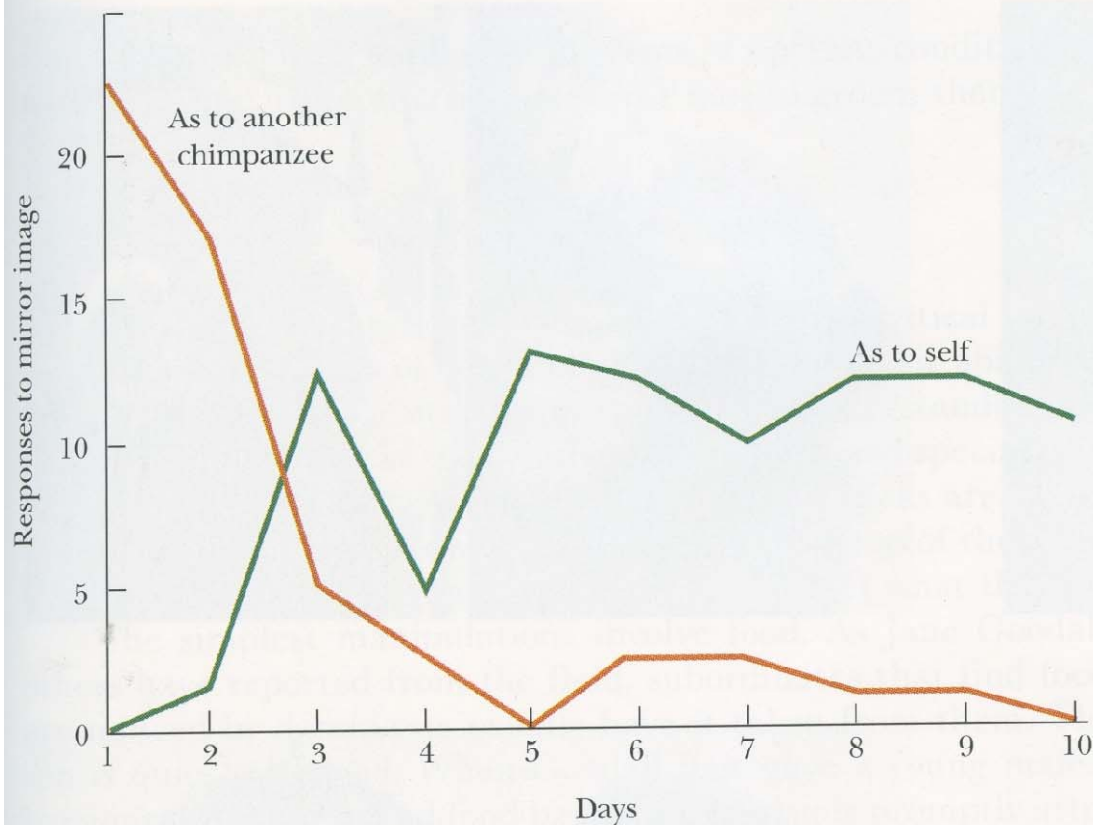


# Self image– Self awareness?



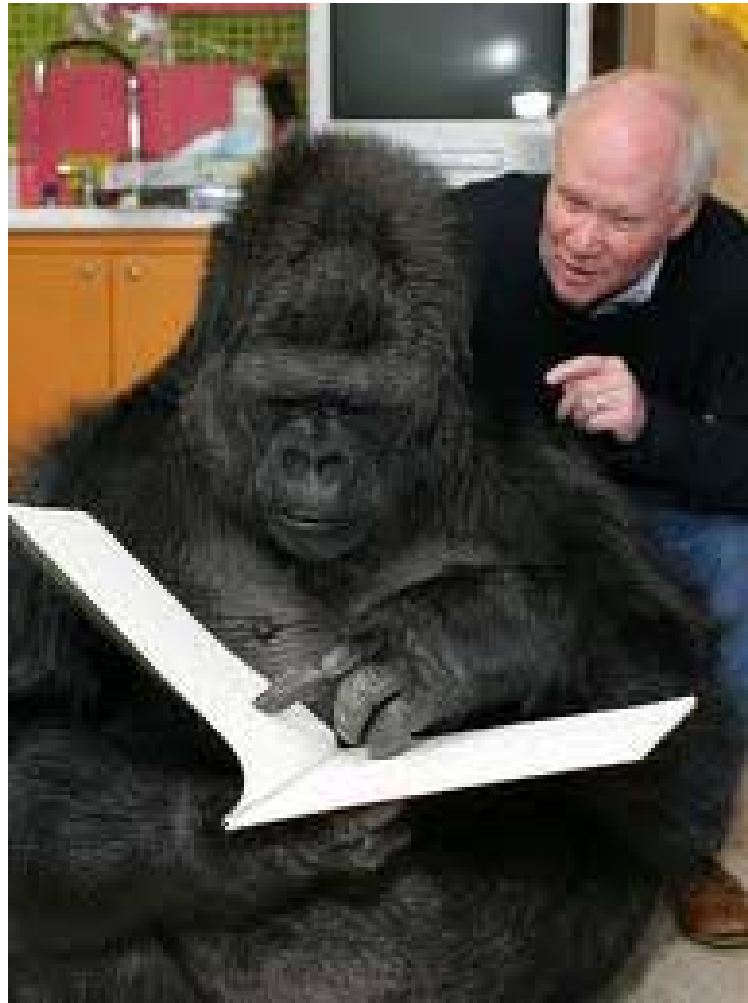
I think therefore I am?

# Self-Image (self-awareness)

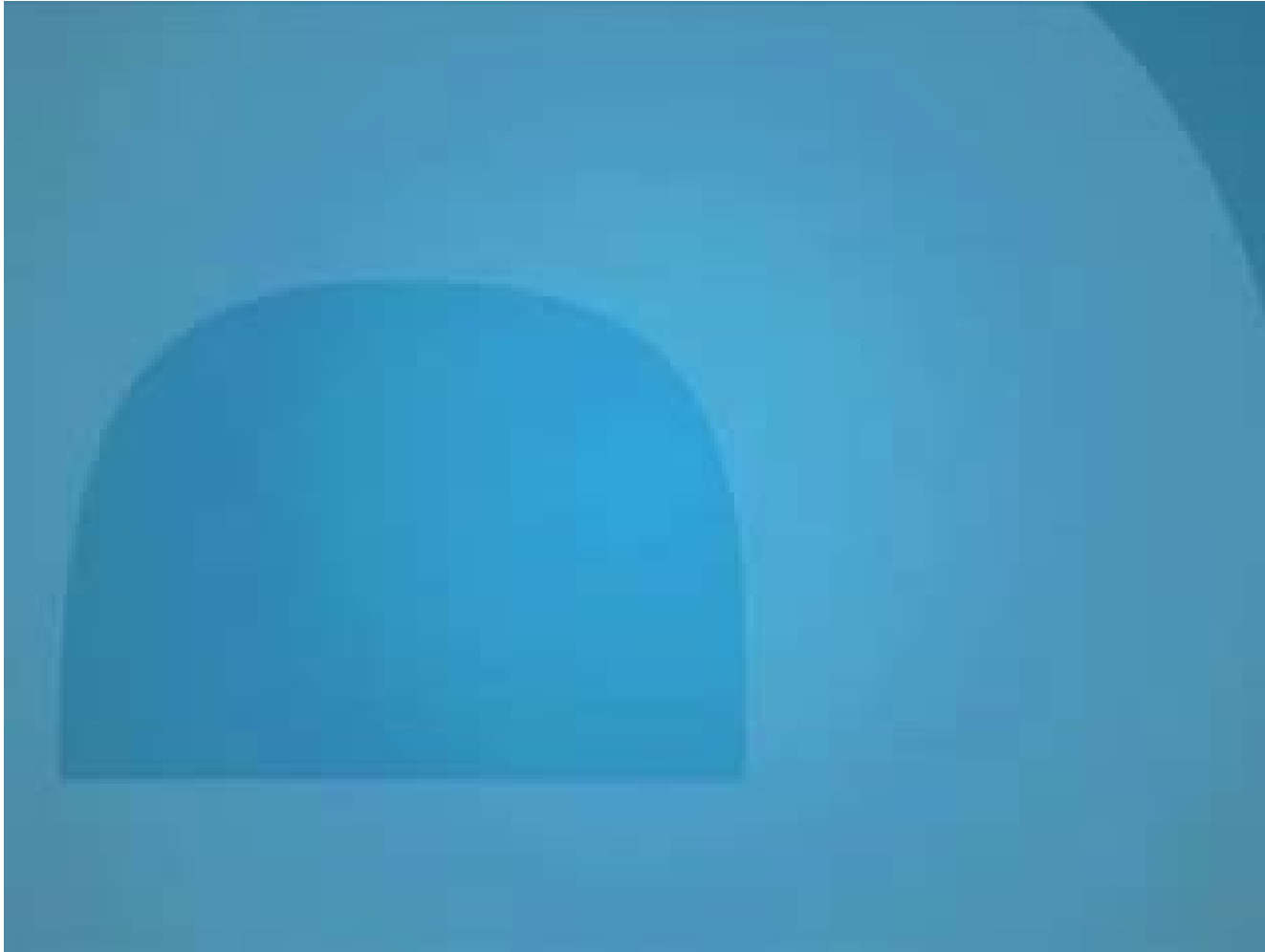


Chimpanzees respond initially to a mirror image as though it were another chimp, reacting with social gestures. Within a very few days, however, the chimp figures out what is going on and begins using the mirror for self-grooming.

Koko the gorilla used a mirror to apply makeup



Even some birds can do it too...



Magpie (crow family)

# What animals pass the mirror test?

1. Elephants
2. Chimpanzees
3. Gorillas
4. Bonobos
5. Dolphins
6. Magpie (crow family)





Value of the mirror test may apply to animals who rely primarily on vision. Other animals that fail the test: not mean they don't have self-awareness



when animals can recognize, memorize, interact  
with other individuals,  
do animals have emotion?

# Emotion

a strong feeling deriving from  
one's circumstances, mood, or  
relationships with others:  
joy, anger, love, hate, fear,  
sadness,

# Rats laugh when you tickle them



[www.FreeScienceLectures.com](http://www.FreeScienceLectures.com)

# Ultimate causes of emotions:

## Why do animals evolve emotions?

Darwin: Natural selection will favor evolving of emotions to enhance survival and reproduction  
-- particularly for learned behavior (high flexibility)

Associative learning (Classical conditioning):

Associate survival/reproductive needs with emotion

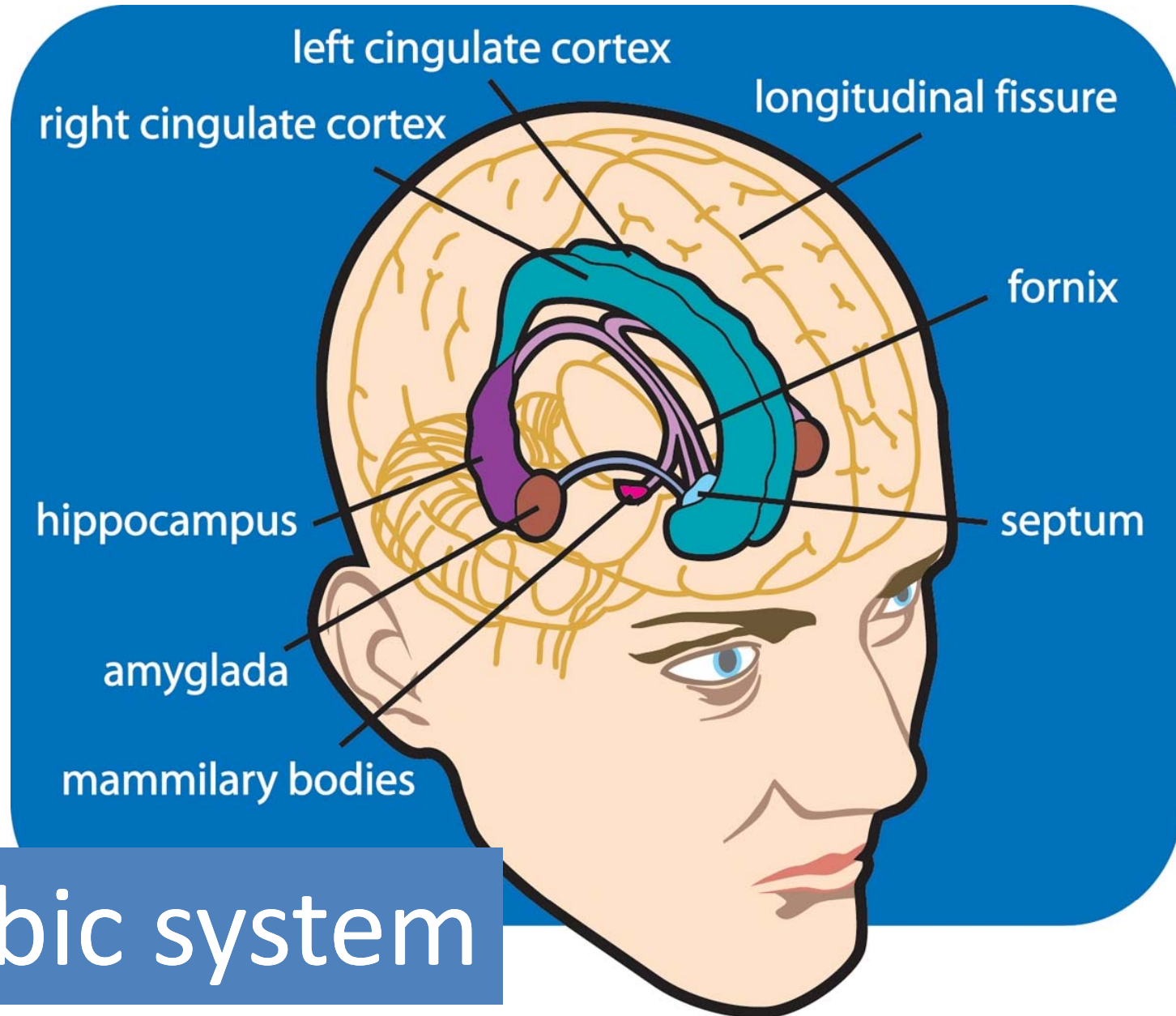
Rewarding response:

Fear response:

Hate, love, anger:

# Elephant's emotions (video clip)

# Proximate causes of emotions:



# Feeling : somatosensory cortex



Comparative studies of animal brains may help us better understand the evolution of emotions.

---

when you can “think” of yourself, feel your emotions, and you recognize, interact with other individuals, can you relate your feelings to others?

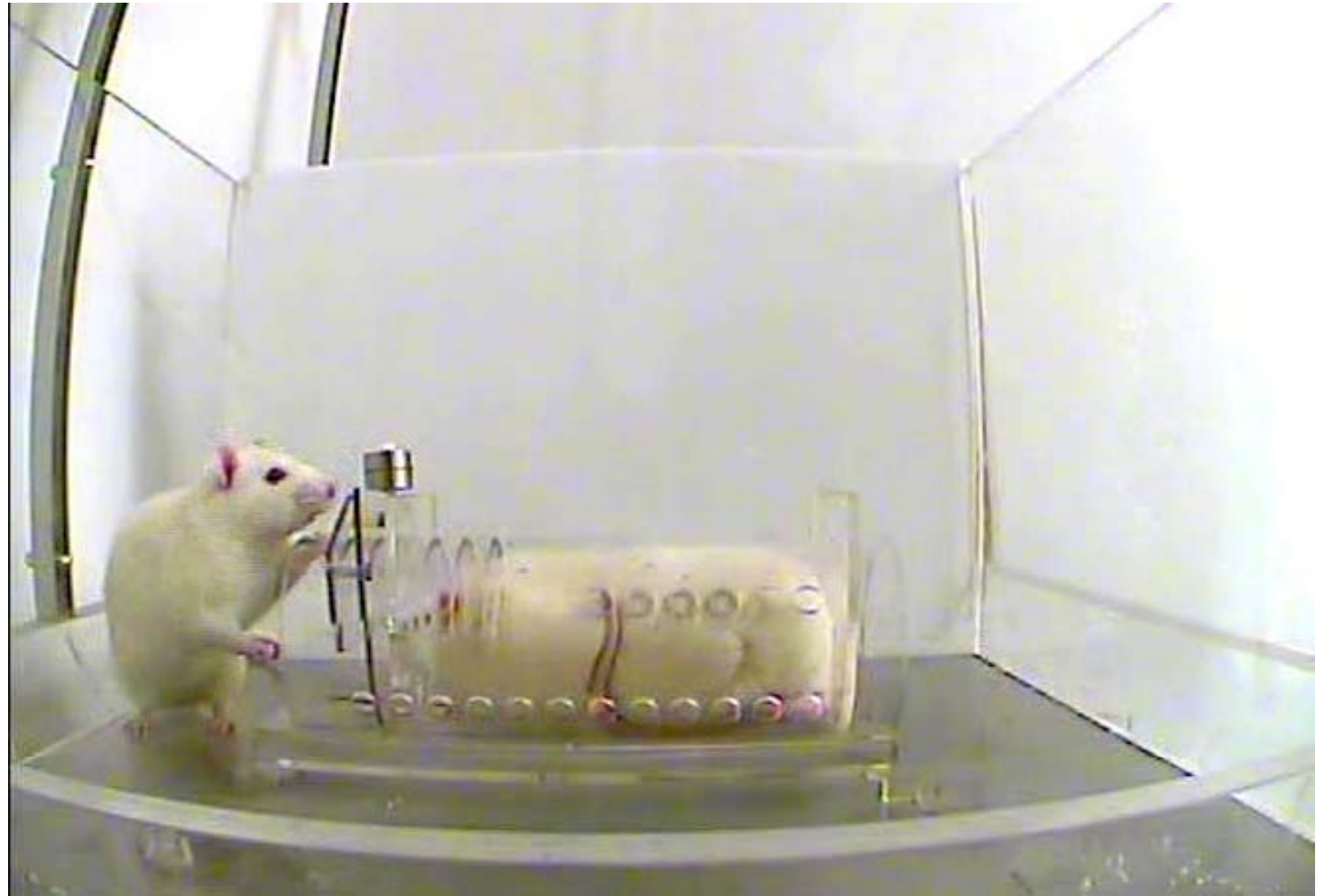
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## Empathy?

The ability to understand and share the feelings of another.



# Empathy in rats (to eat or to help)



# Elephants mourn the dead



# Hippo's empathy



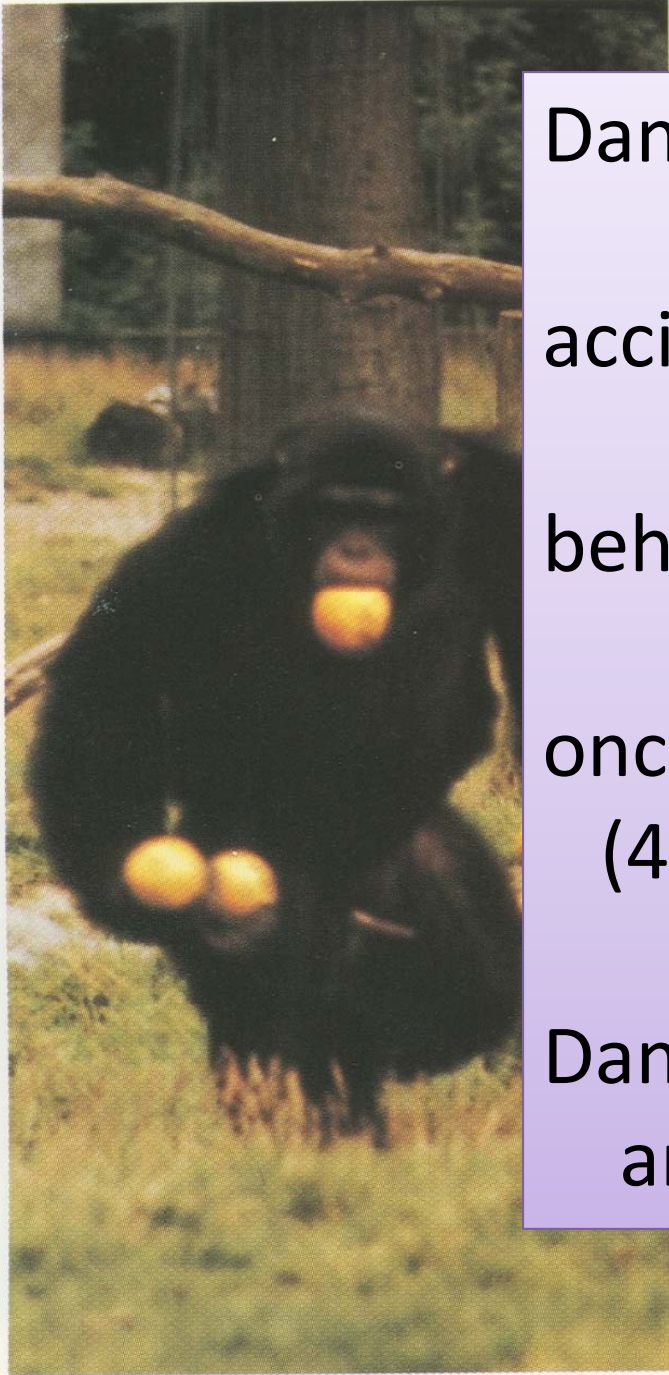
[ebaumsworld.com](http://ebaumsworld.com)

If an animal can recognize itself and others  
can recognize the social status  
can understand what signals mean

Then the animal might know how to  
“manipulate” others...  
-- deception, trickery

# Trickery and deception

Many examples  
in chimps, monkeys...



Dandy (a subordinate chimpanzee)  
accidentally discovered food source;  
behaved as if he didn't know the food  
once dominants were asleep;  
(4 hours later)

Dandy returned to the food source  
and ate all the food.

# 1. Food manipulation in Chimpanzees

1. Gave a young male some bananas, he uttered loud food barks; then attracted older dominant males, bananas were taken by older males
2. The next day gave the same young male bananas, he made “faint” choking sounds

Pioneered study by Jane Goodall





A subordinate male checks to make sure no dominants are watching before attempting to mate with the female.

If a female monkey has a rendezvous with a subordinate male behind a tree, she peeks out periodically to check on the alpha's movements, or exposes her head and pretends to be foraging.





Female chimp may feign indifference when solicited by a subordinate male within sight of a dominant. When out of sight of the alpha, the same females solicit copulations from the favored subordinate and suppress the normal screams that accompany climax.



A chimp called Kanzi was notoriously mischievous, and frightened a new keeper by disappearing; a complete search of his quarters, roof and all, failed to locate the chimp. As it turns out, Kanzi had flattened himself on a bed, covered his body with blankets, and lain completely still for 20 minutes, only to emerge laughing when unable to contain himself any longer.

# Development of cognitive behavior

Play

# What is play?

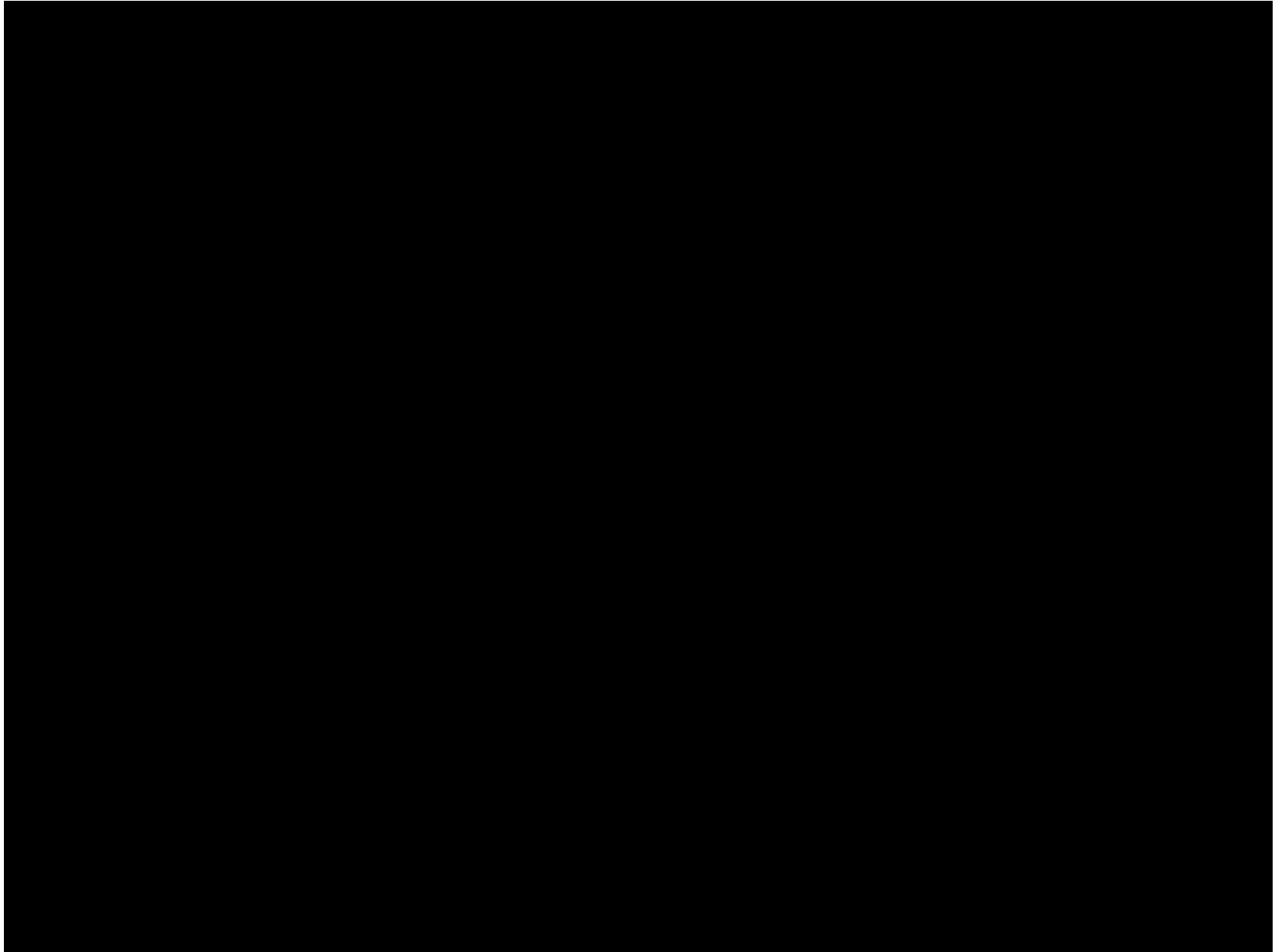
Play is all motor activity that appears to be purposeless, in which motor patterns from other contexts may often be used in modified form.

If the activity is directed toward another living being – social play

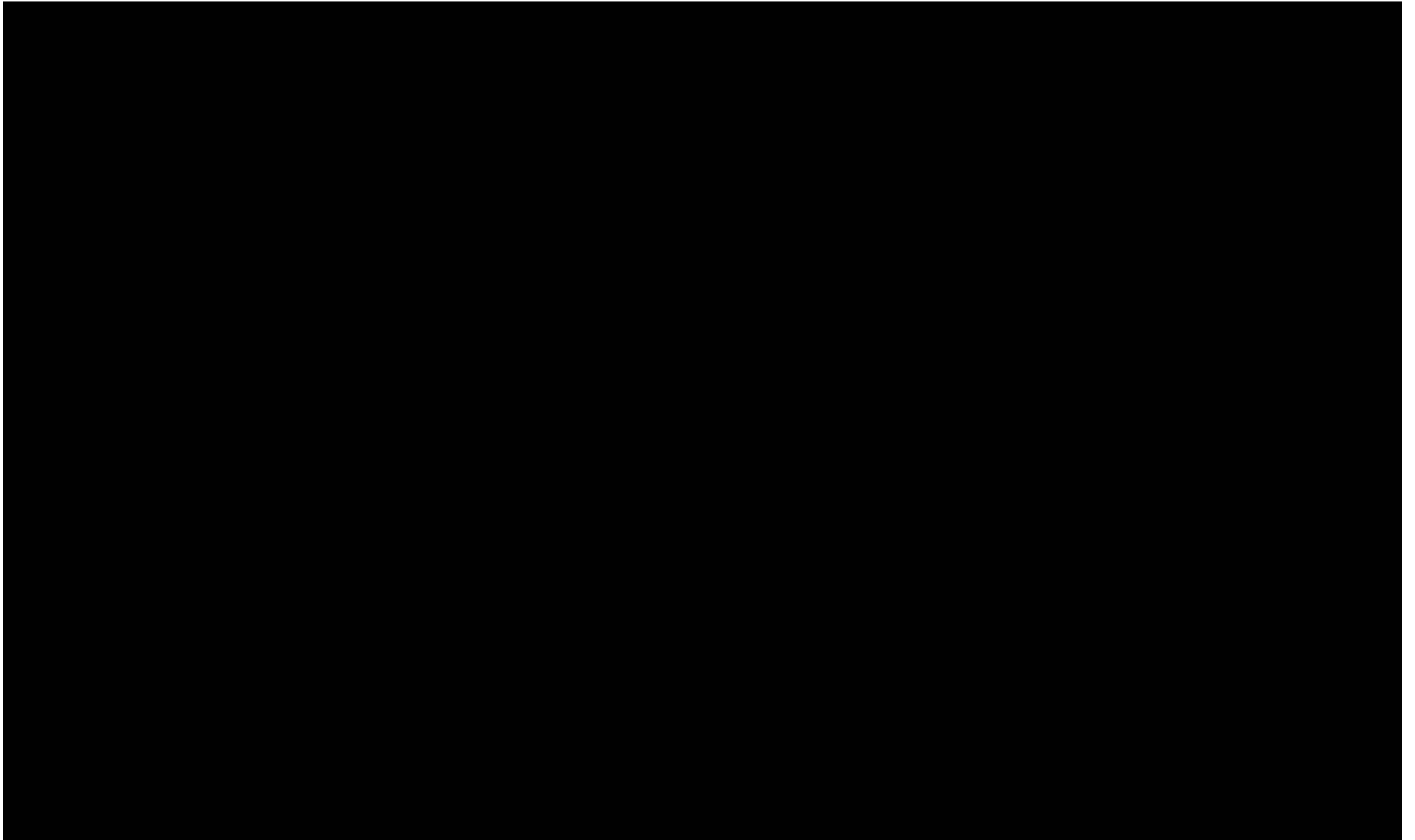
# Do invertebrates play?

Honey bees: play-flight

Birds—Ravens play in the snow

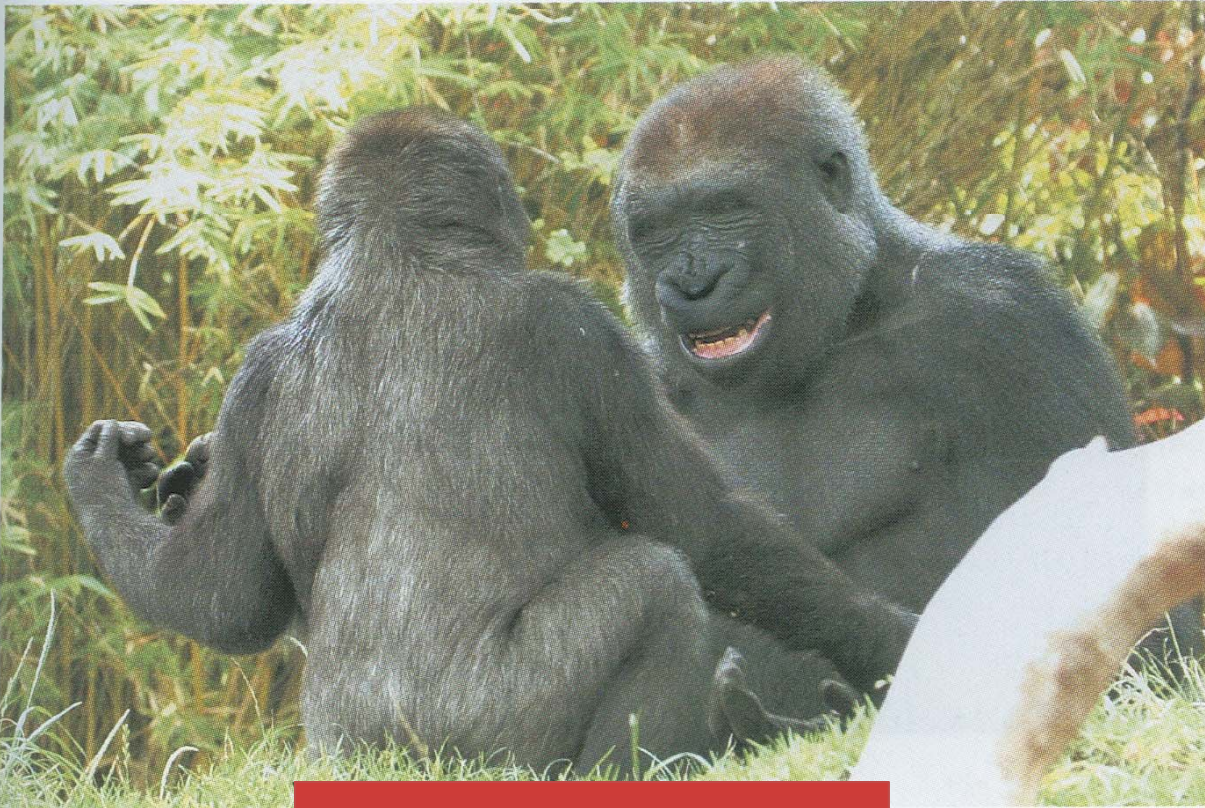


# Dolphins play air bubbles





# How do animals know they are playing, not involved in real activity?



Play markers

**FIGURE 15.12. Play face in gorillas.**

Preceding bouts of aggressive play, juvenile gorillas use a facial gesture called a “play face,” which appears to signal that “what is about to occur is play.” (Photo credit: William H. Calvin)

# The role of PLAY on Animal Mind

Play is a consistent characteristic of the species we see as highly intelligent

-- play is connected to some important aspects of cognition

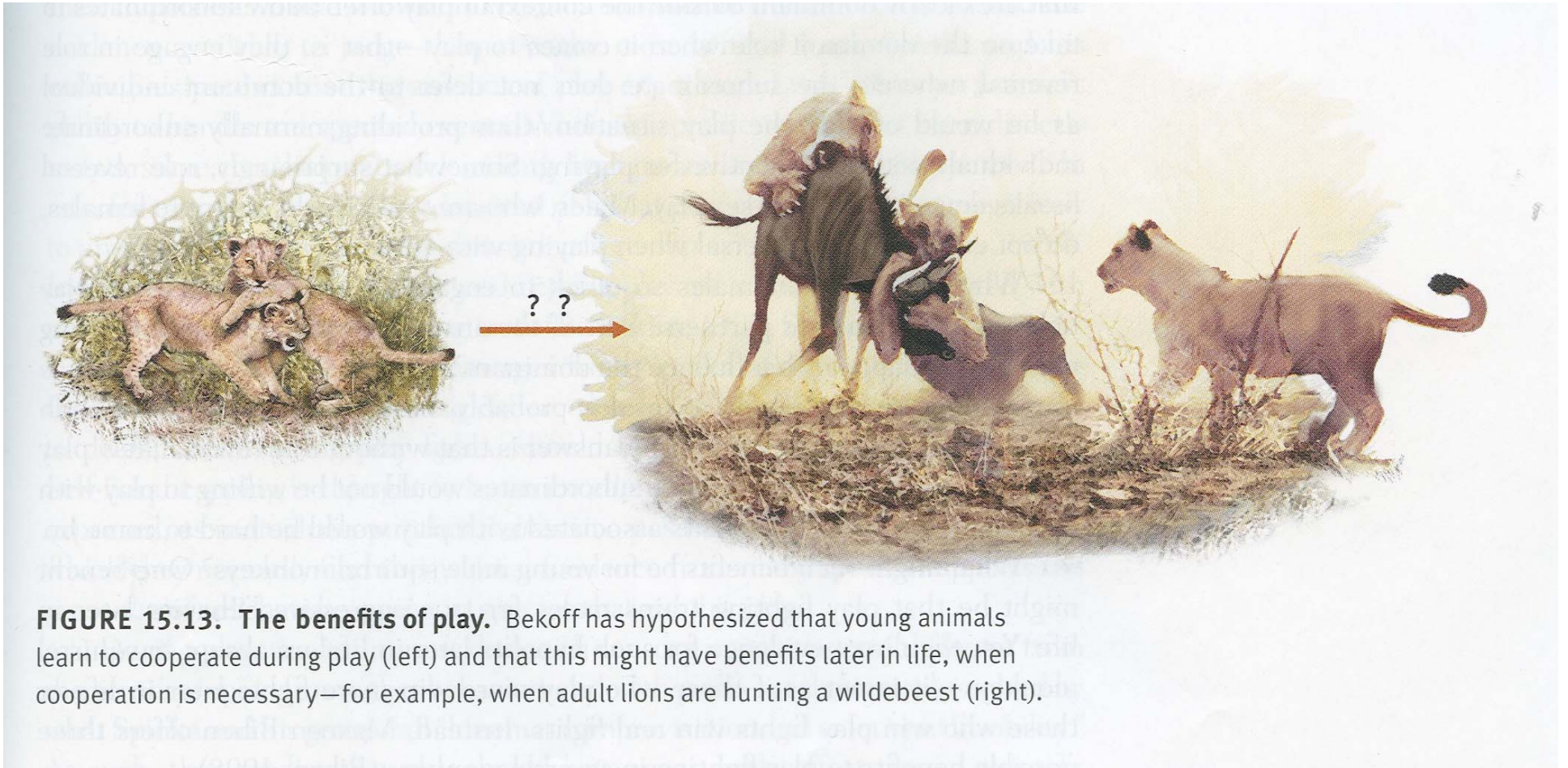
# Ultimate causes of play

Why do animals play?

1. Play aids in the development of cognitive (mind) and motor skills
2. Play promote kin recognition/  
social learning



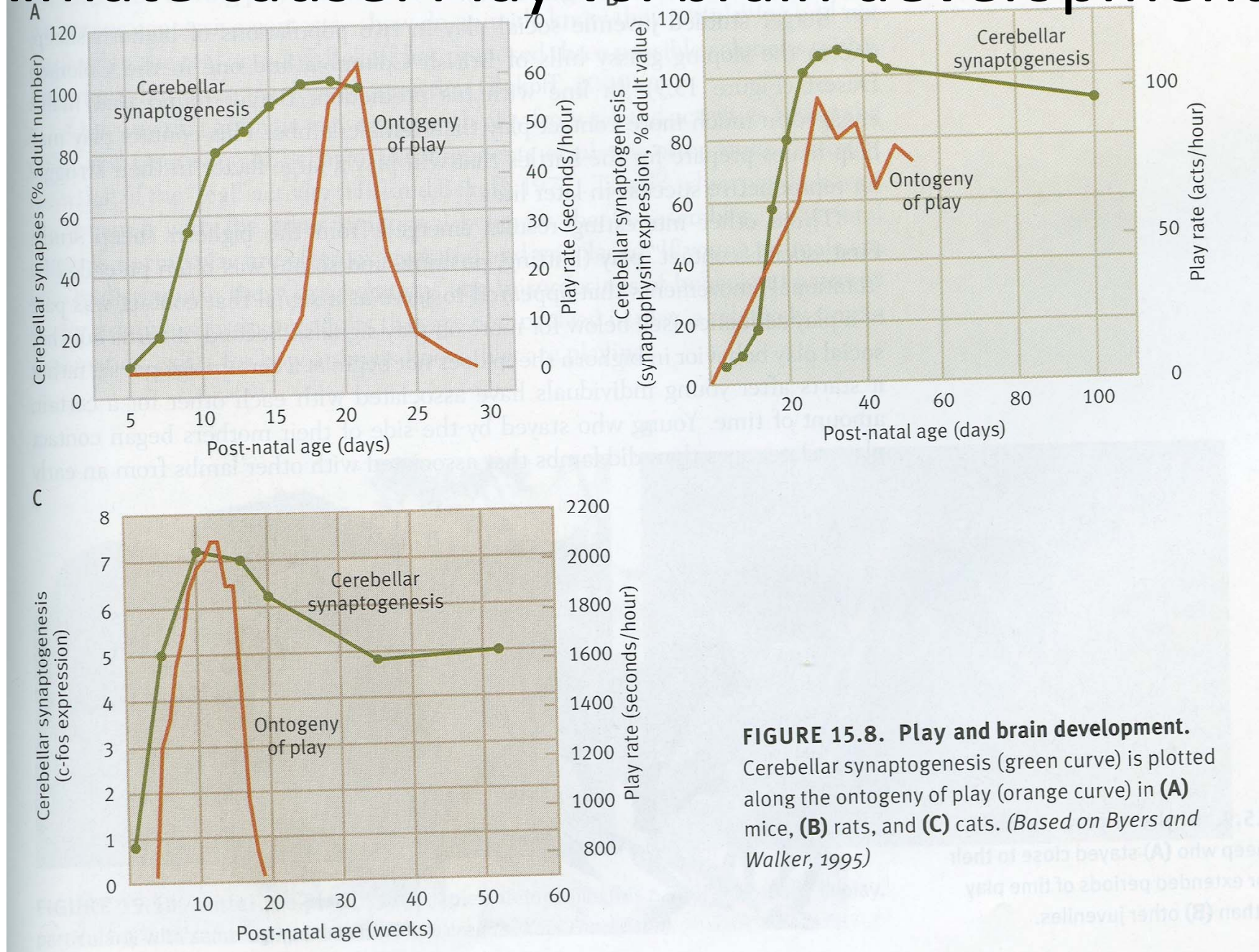
# Function of social play



**FIGURE 15.13. The benefits of play.** Bekoff has hypothesized that young animals learn to cooperate during play (left) and that this might have benefits later in life, when cooperation is necessary—for example, when adult lions are hunting a wildebeest (right).



# Proximate cause: Play vs. brain development



**FIGURE 15.8. Play and brain development.** Cerebellar synaptogenesis (green curve) is plotted along the ontogeny of play (orange curve) in **(A)** mice, **(B)** rats, and **(C)** cats. (Based on Byers and Walker, 1995)

# Proximate causes of play

## Play fighting and hormones in rats

1. Higher testosterone  $\leftarrow \rightarrow$  more play-fight
2. Brain hormone (dopamine, serotonin...) associated with play-fight
  - often times, play is fun (emotions)